Systematic Analysis of Uranium Isotopes

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We describe recent LANL nuclear model calculations and evaluations of neutron reactions on uranium isotopes in the keV – 30 MeV range, for uranium isotopes from $^{232-241}$U. This work makes use of extensive sets of measurements for fission, (n, xn) and capture, as well as fission probability data. The ^{235}U(n, f) standard cross section was revised on the basis of improved experimental data, and the fission cross sections of the uranium isotopes, as well as ^{237}Np and ^{239}Pu, were updated using the revised standard. Nuclear reaction model calculations were performed for the whole suite of uranium isotopes to allow us to take advantage of the systematical properties from isotope-to-isotope, which is especially useful for nuclides where few measurements exist. In addition to improving the neutron cross sections and energy-angle distributions, new prompt fission neutron spectra and prompt/delayed neutron multiplicity evaluations are included for several isotopes.

We shall focus on some of the critical evaluations, especially ^{233}U, ^{235}U, and ^{238}U, where our evaluation work was performed iteratively with important feedback from integral data testing (critical assemblies in the fast and thermal region, and 14-MeV pulsed-spheres). Our new evaluations solve some long-standing problems, for example: (a) ^{238}U inelastic scattering is better modeled, which has a positive impact on the criticality of thermal assemblies as well as faster assemblies; (b) ^{238}U reflection is better modeled in the fast region; (c) criticality of fast systems involving ^{233,235,238}U is accurately reproduced, including that of ^{233}U. We will focus on the cross section improvements (including theory predictions) that have led to this improved performance.

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